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# A STUDY ON FISH REPRODUCTION WITH REFERENCE TO AQUATIC VARIATION IN KOSI RIVER ZONE OF BIHAR

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***ABSTRACT***

***Reproduction in fish is environmentally regulated by several factors. Variation in aquatic environment like water body type, photoperiod, aquatic pH, food availability, vegetation etc are some important factors. The effects of climate change on aquatic species will vary with latitude, habitat, water column characteristics, and in riverine systems, flow regimes. However, some general expectations of climatic change are for possible phase-shifting of seasonal temperature profiles, elevated seasonal maxima and minima, and as a consequence of increases in atmospheric CO2, increasing water acidification. Riverine habitats are likely to experience elevated temperatures in association with decreased flow rates and increasing incidence of hypoxic conditions, but with quite marked regional differences in effect. In the present study an attempt has been made to analyse the main objective like the effect of aquatic variation on fish reproduction. Further, it has been sought to evaluate the effect in the natural habitat of fishes as well as in captivity in laboratory. The universe of the study is Kosi River Zone of Bihar. This study has revealed that the quality of water body has great effect on fish reproduction. A total of 146 species belonging to 10 orders, 27 families and 61 genera were recorded from Bihar. Present study includes 24 species of fishes of which 19 were reported from Southern Saharsa and 05 from Northern Saharsa. Out of which, Cyprinidae was the most dominant family recorded. The sperm of common carp (L. rohita) had a lower motility when the pH value varies between 8.0 and 9.5. In our experiment, eggs fertilization was maximum at pH 3-9. pH values above 9.0 were found to be lethal. In acid solutions, Hatching rates were higher than those in alkaline solutions. The fishes of koshi region has a wide pH range for hatching. The various developmental stages of fish eggs showed different sensitivities to water pH. Embryo segmentation stage is the most sensitive stage. Resistance increased after this stage, wherein eggs hatched in alkaline solutions, even at pH 10, with a hatching occurs at lower rate than at pH 9.0 and pH 8. These data suggested that L. rohita (cyperinidae) fish eggs were less sensitive to acid and alkaline stress. A significant difference was observed between hatching times. Although the hatching rate was lowest at pH 10, the hatching time was the shortest. Hatching time increased with decreasing pH values. In this experiment, hatching time was longer than those recorded under field conditions, which may be attributable to experimental conditions being less stable than field conditions. in our experiment, The eggs were seemed to suffer more artificial stress from factors such as pH adjustment and water change.***

***KEYWORDS: Fish, Reproduction, Aquatic Variation, pH, Hatching***

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Original Article

## INTRODUCTION

Reproduction in fish is environmentally regulated by several factors. Temperature anomalies and variation in aquatic environment like water body type, photoperiod, aquatic pH, food availability, vegetation etc are some important factors. The effects of climate change on aquatic species will vary with latitude, habitat, water column characteristics, and in riverine systems, flow regimes. However, some general expectations of climatic

change are for possible phase-shifting of seasonal temperature profiles, elevated seasonal maxima and minima, and as a consequence of increases in atmospheric CO2, increasing water acidification. Riverine habitats are likely to experience elevated temperatures in association with decreased flow rates and increasing incidence of hypoxic conditions, but with quite marked regional differences in effect.

pH is the main factor affecting water quality. Various experiments shows that fish eggs were fertilized at pH 3-12, Fertilization rates from pH 3 to 12 were above 70%. Extreme pH negatively affects fish growth and reproduction and may causes massive mortalities too. A significant difference was observed between hatching times. Hatching time increased with decreasing pH values. High pH caused by the vigorous photosynthetic activity of aquatic plants, along with high temperatures together with other factors may also affect fertilization and hatching and ultimately mortility in fishes. In the present study an attempt has been made to analyse the main objective like the effect of aquatic variation on fish reproduction. Further, it has been sought to evaluate the effect in the natural habitat of fishes as well as in captivity in laboratory. The universe of the study is Kosi River Zone of Bihar. Further this study has revealed that the quality of water body has great effect on fish reproduction. Sensitivity to extreme pH conditions varies according to fish species and age. Generally, the effect of low pH on fish fertilization and hatching is not often a subject of research except in salmonids (Sayer et al., 1993). Therefore, in this study, we investigated the effects of a wide range of pH on the mortality, fertilization, and hatching rates of fresh water carp *Labeo rohita* eggs.

Scholar made a review of fresh water fishes from Bihar. A total of 146 species belonging to *10* orders, 27 families and 61 genera were recorded so far from Bihar. This includes 24 species of fishes of which 19 were reported from Southern Saharsa and 05 from Northern Saharsa. They also noticed that species richness was more in Southern Saharsa than that of Northern Saharsa. Cyprinidae was the most dominant family recorded .

Scholar has studied the effect of aquatic variations on the fishes of study area in saharsa and most of observation and result are made in their natural habitat. However, for study of effect of temperature and aquatic variations in captivity, some experiments were also performed on *L.rohita* commonly known as ‘Rohu’ at Zoology lab of T.P. College, Madhepura of B.N.M. University, Madhepura.

**Effect of Aquqtic Variation (Water Quality) with Reference to pH**

The water pH is the main factor affecting water quality. Water sample from natural hahitat are collected and their pH is measured using litmus paper test. It is found that fishes in natural habitat of study area reproduce in pH range of 3-12. Extreme pH negatively affect fish growth and reproduction.

Here, for knowing the effect of change in pH on fish reproduction specially on fish fertilization and hatching in carps some study was conducted in captivity at Zoology lab of T.P. College by scholar under supervision of guide. Therefore, in this study, we investigated the effects of a wide range of pH on the mortality, fertilization, and hatching rates of fish eggs.

- **Preparation of pH Solutions**

Water with a pH of 7.34, was used as the control water. pH solutions ranging from 2 to 13 were adjusted using 1N sodium hydroxide (NAOH) and 1N hydrochloric acid (HCI). For the observation of fertilization, 5ml of solutions having different pH value was added to Petri dishes. In experimental Laboratory, Room Temperature (25˚C) was maintained and pH was measured with a pH meter. pH was tuned every hour and the solutions were wholly changed every 8 hr during all

experimental periods.. For the hatching experiment, 200 ml of pH solution was added to a 400-ml beaker, and solutions were aerated with an air pump to ensure sufficient dissolved oxygen (above 7 mg/L). Both Fertilization and hatching experiments were performed for each pH level in triplicate.

- **Egg and Sperm Collection**

The experiment was performed at the Zoology Laboratory. Three-year-old brood fish of genus *L. rohita* 'commonly called as Rohu' were selected and kept isolated in holding tanks. These fish were then stocked for 12 hr at a water temperature of 28 ± 0.5˚C after using intraperitoneal injections of human chorionic gonadotropin (HCG) at the rate of 10,000 IU/kg body weight to induce spawning in female brood fishes. Eggs were stripped into a dry petri dish. However, Sperm collection is done by surgical removal of the male fish testis. The testes were pooled in physiological saline (NSS). Some of the stripped eggs were fertilized immediately with milt as soon as the sperm activation was initiated by the addition of water. Sperm from one male were used to fertilize eggs from one female only.

- **Fertilization and Hatching Rates**

Fertilization membranes formed immediately when an egg was fertilized. This feature helps in counting number of fertilized egg at different pH. To observe the fertilization rate, we place 50 eggs into 5 ml pH solutions; the we injected sperm into the dish and mixed equably, and after about 1 min of gentle stirring, fertilization could be checked under a dissection microscope (10~100x magnification). The Fertilization rates were calculated as:

$$\text{Fertilization rate} = \frac{\text{The number of fertilized eggs}}{\text{The number of total eggs}}$$

Hatching was defined as the rupture of the egg membranes by the tail. However, hatching time was recorded as the time spend between fertilization and the hatching of the last egg. To determine the hatching rate, we placed randomly 50 fertilized eggs into the 200 ml prepared pH solutions. Mortalities and hatching rates were then recorded under microscope during the experimental period. Eggs were considered dead when parts of the content turned opaque and white.

$$\text{Hatching rate} == \frac{\text{The number of hatched eggs}}{\text{The total number of eggs}}$$

**Data Analysis**

Data were analysed by one way analysis of variance to compare the mean value at different pH levels. $pH < 0.05$ was considered to indicate a significant difference.

**Results and Discussion of Effect of Water pH on Fish Reproduction**

In this study, the experiment shows that *L.rohita* fish eggs were fertilized at pH 3-11 (Figure 1). This was a considerably wide range compared to other fish species, suggesting that *L. rohita* (rohu) fish eggs were more tolerant of extreme pH conditions. Fertilization rates from pH 4 to 8 were above 70% and obviously higher than those at pH 3, 9,10, and 11. The fertilization rates generally declined with extreme acidic or alkalinity concentrations.. No fertilization occurred at pH 2 or 13. The fertilization rate may have been decreased due to the effects of water pH level either on spermatozoa motility or on eggs viablity. The egg membranes dissolved at pH 2, although, eggs became opaque and white at pH above 12in short time.

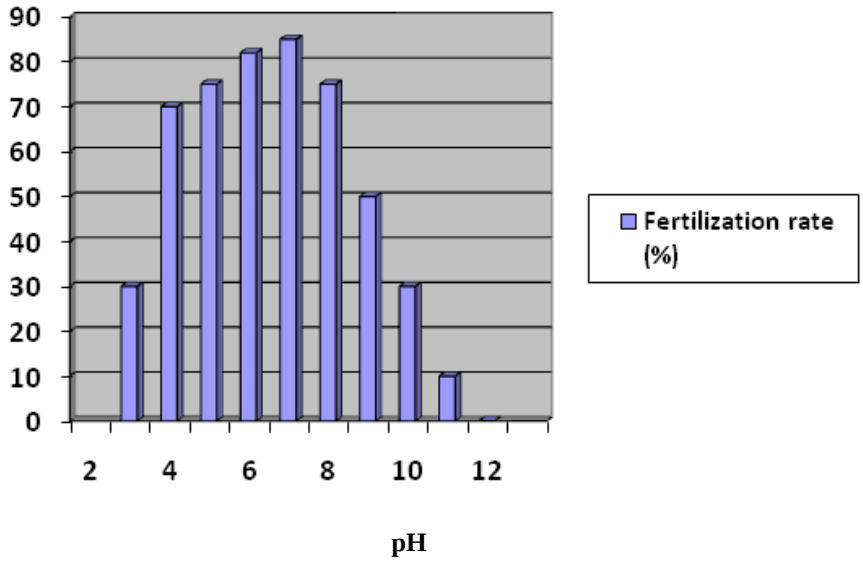


**Figure 1: Fertilization Rate of *L. rohita* Fish at Different pH Level**

The sperm of common carp had a lower period of motility when the pH value of the water varied between 8.0 and 9.5, and pH values above 9.0 were found to be lethal. In our experiment, eggs could be fertilized at pH 3-9.. The period of sensitivity to acidity and alkalinity appeared to be the first few hours after fertilization till hardening of egg membrane.. This phenomenon has also been reported for other species of fish by other researchers. However, after hardening, the chorion and the plasma membrane form a resistant barrier to protect the developing embryo from external media.

Hatching rates in acid solutions were higher than those in alkaline solutions. This was supposed to be a wide pH range for hatching compared to other fish species. However, fewer reports have described the tolerance of fish to alkaline solutions, and generally, the pH range of 5-9 is accepted as harmless to fish. No obvious difference was seen between the control and pH 4, 5, 6, or 8 solutions, but control rates were significantly higher than those in pH 9 and 10 solutions. In this experiment, Scholar found that for rohu eggs mortalities occurred above a pH value of 9.0, depending upon length of exposure also. The various developmental stages of fish eggs showed different sensitivities to different water pH. Embryo segmentation stage is the most sensitive stage. Resistance increased after this stage, wherein eggs hatched in alkaline solutions, even at pH 10, with a hatching rate of about 30%, followed by pH 9 (50%) and pH 8 (65%).. These data suggested that rohu fish eggs were less sensitive to acid and alkaline stress.

Hatching times showed significant difference. Hatching time increased with decreasing pH values. Although the hatching rate was lowest at pH 10, the hatching time was the shortest, with hatching beginning 27 h after fertilization and ending at the 31st h. The eggs in pH 4 solutions did not start hatching until 53 h after fertilization, and 64 h were required for all eggs to hatch. In this experiment, hatching time was longer than those recorded under field conditions, which may be attributable to experimental conditions being less stable than field conditions. The eggs in our experiment seemed to suffer more artificial stress from factors such as pH adjustment and water change. Few reports exist on the hatching times of eggs under alkaline conditions, and this accelerated hatching was observed in the present experiment. However, the reason for it remains unclear, and further study is still needed in this field.

## CONCLUSIONS

Variation in aquatic environment like water body type, photoperiod, aquatic pH, food availability, vegetation etc are some important factors. The effects of climate change on aquatic species will vary with latitude, habitat, water column characteristics, and in riverine systems, flow regimes. In the present study an attempt has been made to analyse the effect of aquatic variation on different stages of fish reproduction in koshi region of Bihar. The experiment shows that *L.rohita* fish eggs were fertilized at pH 3-11. Fertilization rates from pH 4 to 8 were above 70% and obviously higher than those at pH 3, 9,10, and 11. The fertilization rates generally declined with extreme acidic or alkalinity concentrations. No fertilization occurred at pH 2 or 13 The various developmental stages of fish eggs showed different sensitivities to different water pH. Embryo segmentation stage is the most sensitive stage. Resistance increased after this stage, wherein eggs hatched in alkaline solutions, even at pH 10, with a hatching rate of about 30%, followed by pH 9 (50%) and pH 8 (65%).. These data suggested that rohu fish eggs were less sensitive to acid and alkaline stress. In this experiment, hatching time was longer than those recorded under field conditions, which may be attributable to experimental conditions being less stable than field conditions. The eggs in our experiment seemed to suffer more artificial stress from factors such as pH adjustment and water change.

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